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*Original Article*

# Sustainable Supply Chain Practices for Scope 3 Emissions Mitigation: An Integrated Modeling and Optimization Perspective

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***Abstract*** *- The biggest part of any company's carbon footprint is made up of scope 3 emissions, which are indirect greenhouse gas emissions that happen along the supply chain. These are also the hardest to measure and cut down on. This study examines the possibility of Sustainable Supply Chain Management (SSCM) strategies for lowering Scope 3 emissions by combining a theoretical framework with data-driven modeling and optimization methods. The study builds a conceptual model that links the purpose of sustainability with the operational strategies in procurement, logistics, and end-of-life management. It draws on frameworks like resource-based view, systems theory, and stakeholder theory. Based on the examination of various industry case studies, such as electronic, textile, healthcare, digitally-traceable, and carbon-informed decision-making, this study demonstrates that collaborative practices, green procurement, digital traceability, and carbon-informed decision-making can help reduce measurable Scope 3 emissions. The article concludes with a framework for integrated optimization to reduce emissions and suggests an approach to close the gap between theory and practice. Policies, corporate sustainability strategies, and the creation of science-based climate targets can all greatly benefit from the results.*

***Keywords*** *- Sustainable Supply Chain Management (SSCM), Scope 3 Emissions, Carbon Footprint, Emissions Mitigation, Sustainable Logistics, Environmental Sustainability, Industry Case Studies, Stakeholder Engagement, Climate Strategy.*

## 1. Introduction

Organizations are now held accountable for more than just their direct emissions of greenhouse gases (GHG) (Scope 1 and 2); they are also held accountable for indirect emissions that occur throughout their value chains (Scope 3 emissions) due to the increasing environmental concerns and aggressive climate targets [1]. The Greenhouse Gas Protocol classifies most emissions as belonging to "scope 3," which includes a broad variety of human activities, from the extraction of raw materials and the operations of suppliers to the final disposal of a product. This category usually accounts for the bulk of a company's carbon footprint. Their importance has not diminished their immeasurability, impossibility to control and cut because of their scattered character and the presence of numerous stakeholders in multifaceted global chains [2].

The necessity of sustainable supply chain practices is urgent to reducing the Scope 3 emissions as global supply chains become more interrelated and dynamic networks. Companies are currently anticipated to not only operate their internal business in a sustainable manner but also to engage in the upstream supply chains with upstream suppliers and downstream customers to facilitate low-carbon shifts across the product life cycle [3]. This requires a paradigm change of the historic cost-based supply chain strategies to combined strategies that incorporate the goal of sustainability as a fundamental objective.

The combination of modeling and optimization methodology in supply chain sustainability activities provides opportunities for finding the hotspots of emissions, assessing alternative sourcing and logistics solutions, and applying practical ways of emission minimization. Mathematical modeling allows firms to track carbon flow over supply chain levels, model the effect of design and policy adjustments on the environment, and integrate sustainability measurements in decision-making processes. Meanwhile, optimization models assist in the trade-offs between cost, service performance, and environmental performance and support evidence-based decisions when striving for a greener supply chain design and operations.

This study analyzes the integrated modeling and optimization in the design and management of sustainable supply chain with emphasis on Scope 3 emissions reduction. It explores best practices, new technologies, and data-driven frameworks that would help companies to measure, report, and cut their indirect emissions [4]. Integrating the latest literature and practical case studies, the paper seeks to provide a holistic outlook of how organizations can use integrated modeling method in orienting their supply chain strategies towards achieving sustainability objectives, regulatory provisions, and stakeholder expectations [5][6].

In the value chain, most of the carbon emissions fall under Scope 3, which includes not only the reporting company's emissions but also those of the other supply chain organizations (Scope 1 and Scope 2). Concerns over

corporate responsibility and carbon accountability have brought Scope 3 emissions into further attention in recent discussions [7]. Businesses, policymakers, and environmentalists are increasing their attention toward Scope 3 emissions and focusing on their details and significance. The goal of this guide is to make Scope 3 emissions more understandable by exploring their types, making connections to Scope 1 and 2 emissions, as illustrate in Figure 1 and Table I, and outlining the importance of actively measuring Scope 3 emissions for companies of all sizes and in all industries, as well as how to reduce them using Net0's AI technology.

Making use of sophisticated analytics and creating a data foundation: Automated information processing of data received on an information basis is based on advanced analytics and artificial intelligence, and the types of data used are invoices, purchase orders, bills of materials, transportation records, and many others. In this manner, can obtain more details regarding supply chains. Scope 3 gases at various aggregates, such as product type, supplier group, and geographical location [8]. Carbon pricing that is fair: To incorporate the price of carbon emissions into business and decisions, use internal carbon pricing of supply chains [9]. Attaching a financial attachment to the emissions in a supply chain would motivate environmentally friendly behavior and make teams accountable to their objectives.

Establishing goals and strategies: Goals should be set in a manner that is confessable to the Paris Agreement. Develop supply chain strategies that outline specific measures of maximizing product design, enhancing logistical performance, obtaining renewable energy, and achieving other objectives. Encouraging suppliers to work together on improving their emissions monitoring, reporting, and reduction capabilities is a great way to boost their capabilities. A culture of collaboration and innovation can be encouraged among suppliers through the provision of training, resources, constructive criticism, recognition, and help in order to enhance environmental compliance [10].

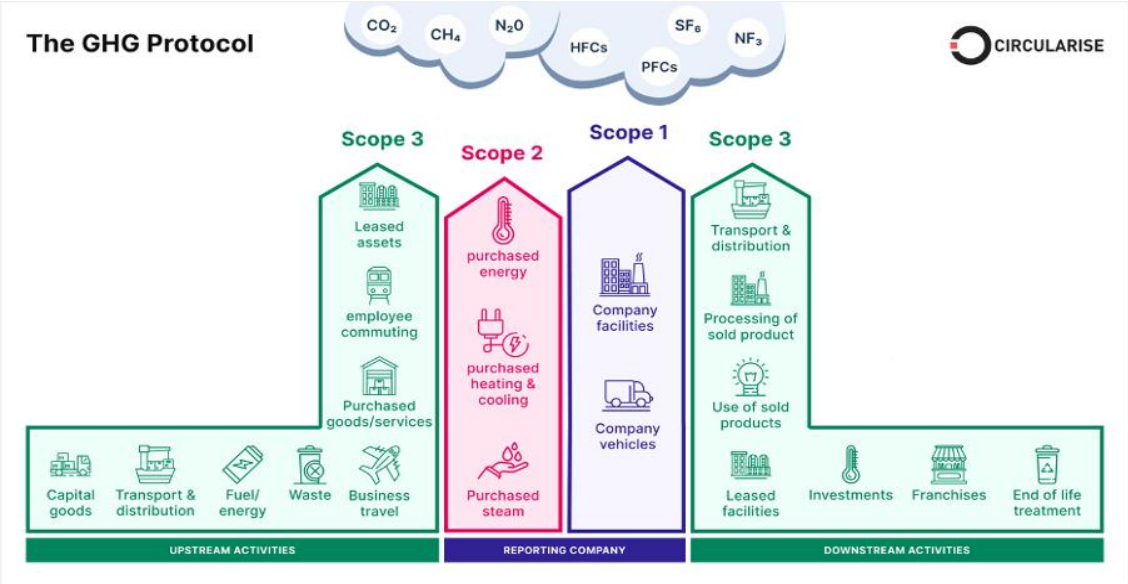


**Fig 1: Scope 1, 2 and 3 emissions**

**Table 1: Comparison of Scope 1, 2, and 3 Emissions**

| Parameter | Scope 1 | Scope 2 | Scope 3 |
|---|---|---|---|
| Definition | Direct GHG emissions from owned or controlled sources | Purchasing power, steam, heat, or cooling results in indirect greenhouse gas emissions. | Indirect GHG emissions from value chain activities not owned/controlled |
| Emission Source | Fuel combustion (e.g., boilers, vehicles), fugitive emissions | Purchased energy (mainly electricity) | Upstream & downstream supply chain activities (e.g., transportation, use phase) |
| Control | Fully within organizational control | Partially controlled (dependent on energy supplier) | Outside direct control, but influenced through procurement and policy |
| Examples | Company vehicles, onsite fuel use, process emissions | Electricity used in buildings, data centers | Supplier emissions, product use, end-of-life disposal, business travel |
| Responsibility | Direct operational responsibility | Operational influence through energy purchasing | Shared responsibility across supply chain actors |
| Measurement Complexity | Easier to measure and report | Moderate complexity, depends on energy provider data | High complexity, requires supplier data and estimations |
| Reporting | Mandatory for most carbon | Usually mandatory or | Often voluntary, but increasingly |

| | | | |
|---|---|---|---|
| Requirement | accounting standards (e.g., GHG Protocol) | recommended | important in ESG and Net-Zero commitments |
| Reduction Strategies | Energy efficiency, fuel switching, carbon capture | Renewable energy procurement (e.g., PPAs, RECs) | Supplier engagement, sustainable sourcing, circular economy models |

### *1.1. Challenges of Measuring Scope 3 Emissions*

Data quality is one of the largest challenges in Scope 3 management. Most firms depend on their suppliers to report on emissions, and this may result in inaccuracy in the reporting because of different reporting standards and data collection techniques. Also, a common problem is the issue of double-counting since the emissions of a single company that are in its Scope 3 inventory report can overlap with those of another company in its Scope 1 emissions. The above aspects complicate the ability of firms to come up with a quality and inclusive Scope 3 emissions report [11]. The solutions offered by Carbmee to these issues are the automated data collection, the improved data validity and the application of sophisticated algorithms to cover the emissions. It also comply with such industry standards as the GHG Protocol, which means that companies be able to implement international reporting standards without any difficulties [11][12].

## 2. Strategies For Reducing Scope 3 Emissions In Supply Chains

The second step is to discover ways to cut down on emissions along the supply chain. This is done after the emissions have been measured. Reduce the supply chain's negative effect on the environment through green product design, the use of renewable energy sources, better logistics, and sustainable suppliers [13]. Closely coordinating with the suppliers and encouraging them to go green is critical in ensuring Scope 3 reduction objectives are attained.

The Carbmee platform allows businesses to measure supplier performance and use it to interact with their partners on sustainability. It enables businesses to make better sourcing choices and apply emissions reduction strategies, which give them visibility into the emissions of their suppliers and provide them with the means of engaging the supplier.

## 3. Sustainable Supply Chain Management and scope 3 greenhouse gas emissions

### *3.1. Sustainable Supply Chain Management*

Corporate social responsibility is increasingly a demand on companies, prompting them to be concerned about the sustainability of their suppliers [14]. The reason why this is the case is in the fact that the sustainability of a company is directly related to the sustainability of its suppliers. Speaking of attempting to make the corporate supply chains more sustainable, the number of ways is quite numerous. The term "supply chain" refers to the interconnected system of entities both inside and across businesses that facilitates the movement of goods, data, and capital [15]. Resilient supply chain management is one of the strategies that has been gaining traction as of late. There is no widely accepted definition of sustainable supply chain management due to the varied and intricate nature of supply chain management across industries and businesses. The fact that sustainability is usually defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" further lends ambiguity to the word [16]." However, this definition is extremely broad and leaves room for interpretation. Traditional supply chain management business operations, such as purchasing, manufacturing, marketing, shipping, and information systems, are incorporated into SSCM by this somewhat nebulous concept of sustainability. The "triple bottom line," an approach that takes into account SSCM, takes into account the monetary, social, and environmental impacts of a company all at once [17].

For instance, SSCM is characterized as "the strategic and transparent integration of an organization's social, environmental, and economic objectives within the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its supply chains" (13). The four SSCM "supporting business sustainability characteristics"—an organization's culture, its level of openness and honesty, its approach to risk management, and its focus on the long-term are also influences. Green Supply Chain Management (GSCM) and Environmental Supply Chain Management (ESCM) are two of several names for the same set of concepts, but they both center on the environmental component of sustainability. "Sustainable supply chain management" is the new label for this initiative. For the sake of this article, GSCM and ESCM are considered to be parts of SSCM, which is the overarching term for all things related to the triple bottom line [18]. Two apparently straightforward, non-exclusive options exist for a business that wants to promote sustainability throughout its value chain. In the first, they seek out partners who are committed to sustainability and do away with those who aren't; in the second, they work together to achieve sustainability. The "hard" and "soft" aspects of SCM are derived from the fields of production management and human resource management, respectively.

The hard, production-oriented dimension encompasses practices like total quality management, green purchasing, green logistics, product innovation, and lean manufacturing. The soft, human resource-based dimension consists of things like top-down commitment, employee engagement, relationships with suppliers and customers, green motivation, and organizational culture. Supply chain management has traditionally been an adjunct to business strategy with the overarching goal of ensuring the efficient and cost-effective delivery of commodities to their final destination [19]. The goal of strategic supply chain management (SSCM) is to improve all three parts of the triple bottom line simultaneously, which is different from past techniques. Sustainable Supply Chain Management practices have the

potential to significantly impact a company's bottom line, community impact, and environmental footprint in relation to factors including supplier development, carrier selection, vehicle route and location, and packaging choices [20]. Environmental and social impacts, in addition to financial earnings, are becoming more important metrics for evaluating a chain's performance in today's supply chain management. The lifecycle effects of business operations take a decisive role in corporate risk management and risk preparation against internal and external shocks, which also underlines the need for SSCM [19]. Therefore, it is unsurprising that SSCM has become an indispensable ingredient of companies that wish to survive in the modern challenging business environment, characterized by fluctuating demand, economic ambiguity, and heightened competition as a result of globalization. The trend amongst academics and practitioners is that the 19th subject is becoming more and more popular as the direct correlation between SSCM, corporate performance and competitive advantage is becoming increasingly evident.

This has led to a rise in the number of studies regarding SSCM over the past several years and SSCM has also become one of the necessary points on business agendas. The results are still not definitive, although the majority of studies have shown that SSCM is associated with improved company success. A study found that when companies engage in cooperative supply chain environmental management, they end up spending more money on environmental impacts [21]. This lends credence to the frequently voiced worry that sustainability policies' financial burdens may cause them to lose competitiveness. While some may argue that supply chain economic performance should take precedence over environmental and social concerns, the vast majority of research actually finds that there is a win-win dynamic between these sustainability characteristics. Although SSCM's triple bottom line benefits outweigh those of traditional SCM, the former is more labor-intensive and time-consuming due to the need to foster alignment and cooperation among chain participants[22]. The absence of demand from end users might also hinder the deployment of SSCM approaches, even though the demand for sustainable products and services is substantial and growing.

### *3.2. Interlinkages between SSCM and scope 3 emissions management*

According to proponents of supply chain and environmental management (SSCM), depicts in Figure 2, two of a company's most fundamental focuses, few have harnessed the potential of their supply chain partnerships to achieve their environmental objectives [23].

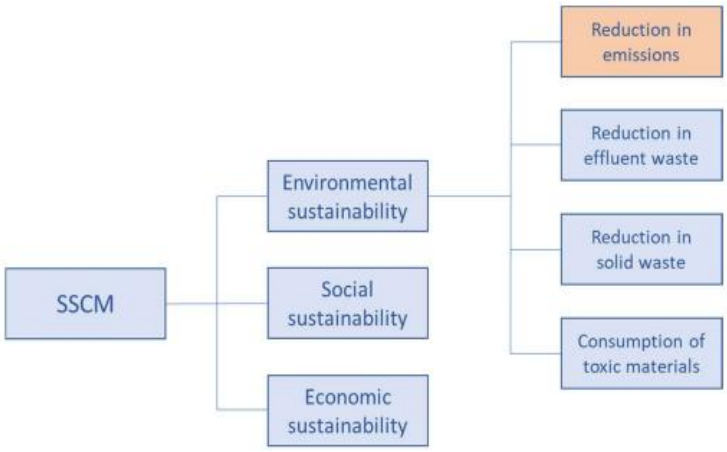


**Fig 2: The Relationship between SSCM and the Management of Scope 3 Emissions**

Consequently, despite the conceptual overlap between the two main topics of contemporary CSR—Scope 3 emission management and Sustainable Supply Chain Management—few studies have investigated the connections and synergies between the two. Scope 3 management has far-reaching consequences for value chain evaluation and configuration, but the SSCM literature has avoided discussing it directly [24], which is the first academic study of their link. Accounting and reporting standards for corporate value chains (Scope 3) (WRI/WBCDS, 2011) draw from SSCM's teachings. However, the standard doesn't address the problems and flaws in SSCM that were pointed out when trying to add sustainability to value chains.

An integral aspect of SSCM and corporate risk management is the management of both direct and indirect emissions of greenhouse gases, as previously stated. Thereby, scope 3 emissions mitigation procedures can benefit from SSCM best practices. When it comes to scope 3 management, one of the biggest problems is a lack of supplier participation and resources. One way to fix this is by using SSCM procedures like supplier co-creation and collaboration, which promote environmental competencies in the supply chain [25]. Through the use of Sustainable Supply Chain Management, businesses can collaborate with their suppliers to decrease emissions of greenhouse gases by implementing environmentally friendly practices and technology. The academic community needs to put more time and energy into studying the connections and synergies between SSCM and scope 3 management, but in the real world, Sustainable Supply Chain Management includes reducing emissions from scope 3, which is an important goal in and of itself. Because scope 3 mitigation is undeniably an important goal of SSCM and because, intentionally or not, SSCM methods are included in scope 3 management initiatives, it might be argued that the two go hand in hand.

### *3.3. Applying SSCM theories to guide scope 3 management and mitigation*

Studies on SSCM have used a variety of theoretical frameworks, such as those dealing with complexity, transaction costs, institutions, systems, networks, resource-based views, social network theory, and resource-dependent theories. The resource-based view is the most popular theoretical foundation for supply chain and supply management (SSCM) studies [26]. According to this view, sustainability is a valuable, scarce, non-renewable resource that can be used to gain an advantage over competitors. Despite the many theoretical frameworks developed and applied in SSCM, most academic literature on the subject is lacking in this area [27]. Even the empirical research in the topic has been characterized as a-theoretical, alluding to the noticeable lack of theory-based methodologies. While this criticism may be somewhat out of date in view of more theory-oriented SSCM research, it does highlight a significant difficulty that the field faces: the famous quotation from where management research does not transition into relevant management practices.

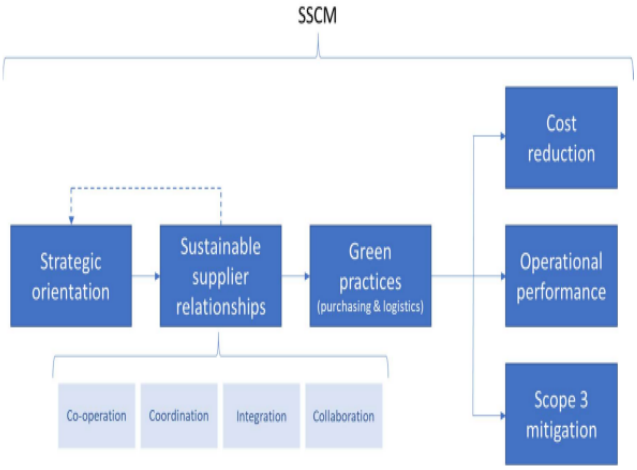


**Fig 3: A Theoretical Framework Applying SSCM Processes To Scope 3 Emissions Management in Purchasing And Logistics.**

The absence of concrete models to direct the adoption of sustainability practices may be the primary cause of the famous knowledge gap in the area of SSCM. This study builds and implements a framework to try to solve this issue from the standpoint of scope 3 emissions management and SSCM. Including all the steps that lead to the intended results, the most important of which is reducing emissions from scope 3 [28]. The framework is an attempt to address the pressing need for more research into the relationship between the more technically focused green practices and the socially focused process of building sustainable supplier relationships, which are examples of the "hard" and "soft" components of supply chain management. As shown in Figure 3, the novel theoretical framework for this investigation was developed by integrating and revising previous works on sustainable SCM [29]. There is still a need for a comparable strategic approach to corporate carbon management, even if reducing emissions within the corporate value chain is a more limited sustainability goal than improving the triple bottom line in its entirety. As a matter of fact, environmental sustainability needs to be made a strategic priority [30]. This calls for buy-in from upper management, a culture that supports it, and the creation of extensive information systems that allow all links in the value chain to be interconnected. Strategic supply chain management is essential for establishing lasting partnerships with suppliers and accomplishing goals that are outside the scope of supply chain knowledge. As supplier engagement is key to successfully integrating supply chain management into company strategy, the connection between strategic direction and long-term supplier relationships is rarely a straight line. Figure 3 shows that the two processes of strategic direction and developing sustainable supplier relationships seem to be enhancing each other, but the framework's theoretical underpinnings failed to detail the feedback loop.

### *3.4. Building Sustainable Supplier Relationships*

All participants in the supply chain needs to work together to avoid harmful sub-optimization if we want to create environmentally friendly methods and, eventually, environmentally friendly goods. In order to implement environmentally friendly practices and decrease emissions of greenhouse gases in scope 3, this section explores the strategies and guidelines for building lasting partnerships with suppliers [31]. The term "sustainable supply chain management best practices" is often used to describe measures that benefit not only society and the environment, but also the bottom line [26]. But economic success is generally thought of as the most crucial factor since, in the long run, the supply chain can't survive without profitability. This study highlights the importance of sustainability from an environmental perspective by examining scope 3 emissions management and reduction. Managers can put this factor ahead of short-term financial results if they think it will be more important for the company's longevity [32]. When it comes to SSCM, trustworthy supplier relationships are defined by open lines of communication, cooperation, and trust. Formal links are necessary for managing the transactional supplier-buyer connection, but in order to build long-term relationships with suppliers, it's important to go beyond that and establish semi-formal links that encourage commitment and social ties among chain participants. The relationship between suppliers and buyers in SSCM is regarded as a partnership as opposed to a formal relationship [33]. This implies that a firm has to put more money on fewer suppliers who are vital to the supply chain instead of treating the supply chain as an array of competitive relationships. The combination of knowledge, assets and the capabilities of the chain enable it to do better and acquire competitive advantage. The traditional paradigm of supply chain management, where members aim to produce interdependencies between them, is in total contrast to the SSCM approach of aiming to produce interorganizational dependencies.

## 4. Case Study

**Case Study 1:** Reducing Scope 3 Emissions in a Mid-Sized Manufacturing Company (as summarized in Table II and visualized in Figure 4):

### *4.1. Company Overview*

- Name: EcoTech Manufacturing Ltd.
- Industry: Electronics and appliance manufacturing
- Location: Pune, India
- Employees: 500
- Annual Revenue: ₹450 crore
- Objective: Identify and reduce Scope 3 emissions across the supply chain using data analytics and technology.

### *4.2. Initial Problem*

EcoTech Manufacturing discovered that their total carbon footprint was more than 70% of Scope 3 emissions:

- Purchased goods and services
- Upstream transportation
- Business travel
- Employee commuting

**Table 2: Reducing Scope 3 Emissions in a Mid-Sized Manufacturing Company**

| Category | Activity Unit | Quantity | Emission Factor (kg CO2e/unit) | Total Emissions (kg CO2e) |
|---|---|---|---|---|
| Purchased Goods & Services | Tons of materials | 1800 | 2.8 | 5040 |
| Upstream Transportation | Km (freight) | 30000 | 0.11 | 3300 |
| Business Travel | Air km | 150000 | 0.13 | 19500 |
| Employee Commuting | Km per year | 200000 | 0.09 | 18000 |
| Waste Generated in Operations | Tons | 300 | 1.4 | 420 |
| Total Scope 3 Emissions | | | | 46,260 kg CO2e |

### *4.3. Actions Taken*

*4.3.1. Supplier Engagement:*

- Switched to local suppliers within 200 km to reduce freight distances.
- Asked suppliers to provide primary emissions data rather than averages.

*4.3.2. Business Travel Policy:*

- Adopted a hybrid meeting policy, reducing flights by 60%.
- Encouraged train travel for distances < 500 km.

*4.3.3. Employee Commuting:*

- **Introduced company-sponsored electric shuttle buses.**
- **Implemented a bike-to-work incentive program.**

*4.3.4. Results after 1 Year*

- Scope 3 emissions dropped by 28% (to ~33,300 kg $CO_2e$).
- Annual cost savings: ₹1.2 crore (fuel, travel, logistics).
- Achieved ISO 14064-1 compliance and improved ESG rating.

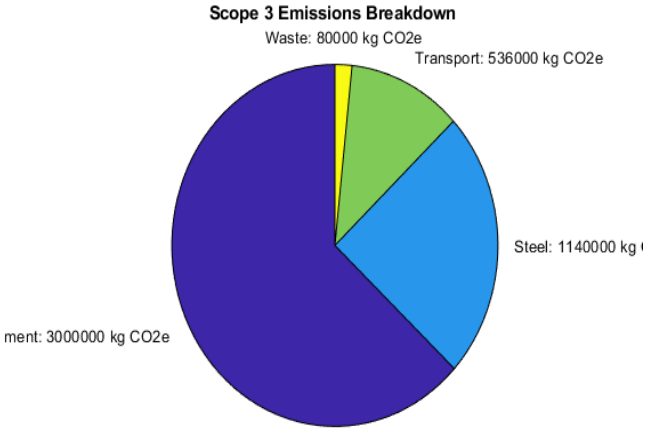


**Fig 4: Reducing Scope 3 Emissions in a Mid-Sized Manufacturing Company**

**Case Study 2:** Scope 3 Emissions Reduction in a Global Apparel Brand (as demonstrated in Table III and Figure 5):

### *4.4. Company Overview*

- Name: GreenThreads Inc.
- Industry: Fashion & Apparel
- Headquarters: Bengaluru, India
- Retail Locations: 320 globally
- Employees: 4,500
- Goal: Decarbonize the value chain and achieve net-zero by 2045

### *4.5. Challenge*

GreenThreads discovered over 90% of its emissions were Scope 3, with the largest contributors being [34]:

- Fabric manufacturing and dyeing in third-party mills
- Logistics and shipping
- Consumer use phase (washing and drying)

**Table 3: Scope 3 Emissions Reduction in a Global Apparel Brand**

| Category | Activity | Quantity | Emission Factor | Emissions (kg CO2e) |
|---|---|---|---|---|
| Raw Material Sourcing | Cotton (tons) | 2,500 | 3.0 | 7,500 |
| Fabric Dyeing & Processing | Meters of fabric | 1.2 million | 0.008 | 9,600 |
| Ocean Freight | Ton-km | 1.5 million | 0.045 | 67,500 |
| Customer Product Usage | Machine washes | 10 million | 0.5 | 5,000,000 |
| End-of-Life Disposal | Items land filled | 1 million | 0.3 | 300,000 |
| Total Scope 3 | | | | 5,384,600 |

*4.5.1. Solutions*

- Supplier Switch: shifted to mills that use waterless dyeing techniques and renewable energy [35].
- Low-Impact Logistics: partnered with shipping routes that are optimized and low-emission freight carriers.
- Consumer Engagement: launched a "Wash Cold, Line Dry" campaign and provided rewards for returning items.
- Recycling Program: started a return program with choices for resale and restoration.

*4.5.2. Outcomes*

- Scope 3 emissions reduced by 32% within 2 years.
- Saved 8.3 billion liters of water and cut energy use.
- Featured in CDP A-list for supply chain sustainability.

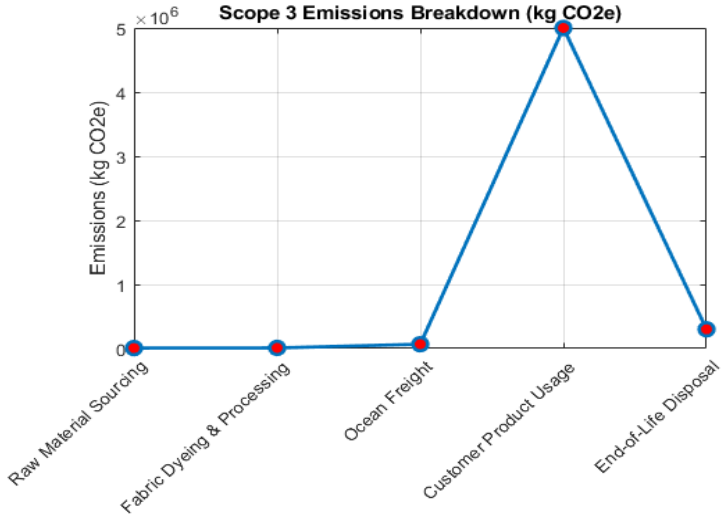


**Fig 5: Scope 3 Emissions Reduction in a Global Apparel Brand**

**Case Study 3:** Scope 3 Optimization in a Tech Company (as detailed in Table IV and depicted in Figure 6):

*4.5.3. Company Overview*

- Name: NetCloud Solutions Pvt Ltd
- Industry: Cloud Computing & SaaS
- Employees: 2,000
- Data Centers: 6 across Asia
- Goal: Report full carbon footprint and minimize Scope 3 from partner vendors

*4.5.4. Problem*

- Purchased servers and networking equipment
- SaaS partner infrastructure
- Employee commuting and remote work

**Table 4: Scope 3 Optimization in a Tech Company**

| Category | Activity | Emissions (kg CO2e) |
|---|---|---|
| Hardware Manufacturing | 5,000 servers purchased | 1,500,000 |
| Cloud Vendor Operations | 10 PetaByte processed | 950,000 |
| Employee Commuting | 800 staff (avg 20km/day) | 240,000 |
| Remote Work (home electricity) | 1,200 staff | 180,000 |
| Business Travel (Flights) | 150 trips/year | 90,000 |
| Total Scope 3 | | 2,960,000 |

*4.5.5. Measures Taken*

- Vendor Transparency: Chose hardware partners with certified carbon footprint disclosures[36].
- Green Procurement: Opted for modular, upgradeable servers to extend hardware lifecycle.
- Green VPN & Cloud Routing: Shifted to vendors with data centers powered by renewables[37].
- Commute Credits: Implemented a green commuter allowance and bike infrastructure.

*4.5.6. Results*

- Scope 3 reduced by **25% in one year**
- Helped attract **ESG-conscious investors**

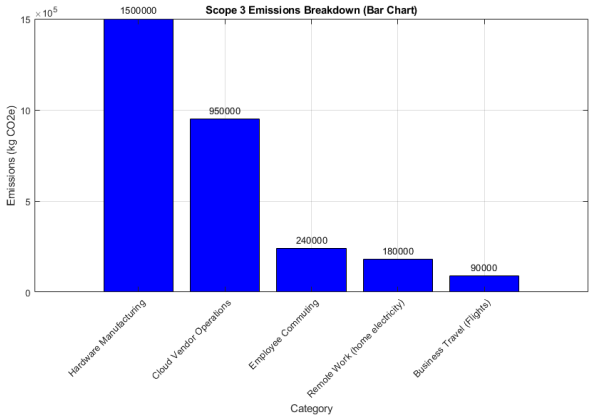


**Fig 6: Scope 3 Optimization in a Tech Company**

**Case Study 4:** Scope 3 Strategy in a Beverage Company (as shown in Table V and illustrated in Figure 7):

*4.5.7. Company Overview*

- **Name:** AquaPure Beverages Ltd
- **Industry:** Bottled water and soft drinks
- **Headquarters:** Hyderabad, India
- **Annual Production:** 100 million liters
- **Objective:** Reduce life-cycle carbon footprint by 40% by 2030

***4.6. Challenge***

While AquaPure had moved to renewable energy in its factories (Scope 2), **Scope 3 emissions were still 85% of its footprint**, especially from:

- PET plastic bottle production
- Raw ingredient sourcing
- Retail distribution logistics
- Emissions

**Table 5: Scope 3 Strategy in a Beverage Company**

| Category | Activity | Emissions (kg CO2e) |
|---|---|---|
| PET Bottle Manufacturing | 250 million bottles | 2,500,000 |
| Sugar & Flavor Ingredients | 15,000 tons | 600,000 |
| Transportation to Retailers | 20 million km (truck) | 1,800,000 |
| Cold Storage at Retail | Energy per display fridge | 750,000 |
| End-User Waste Management | Landfilled bottles | 500,000 |
| Total Scope 3 | | 6,150,000 |

*4.6.1. Solutions*

- Packaging Redesign: Introduced 30% recycled PET, saving ~900,000 kg CO2e.
- Sustainable Ingredients: worked on certified farms that employed low-emission farming techniques[38].
- Distribution Overhaul: Used electric cars with rail-based operations for last-mile delivery.
- Recycling Incentives: To increase the collecting of plastic, a "Return & Win" campaign was started with nearby retailers.

*4.6.2. Outcomes*

- Scope 3 cut by 27% in 18 months
- Won India Sustainability Leadership Award (FMCG category)
- Improved brand image and attracted ESG investors

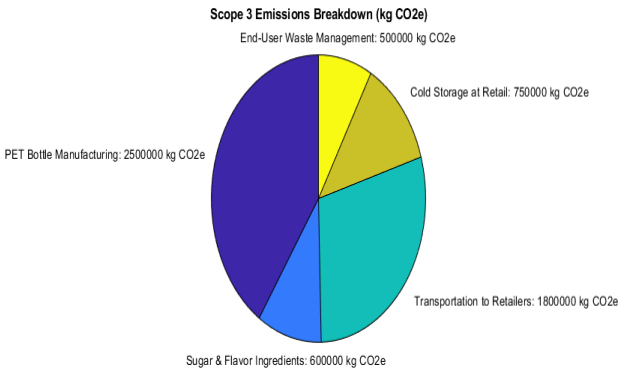


**Fig 7: Scope 3 Strategy in a Beverage Company**

**Case Study 5:** Scope 3 Reduction in Infrastructure & Construction (as presented in Table VI and figure 8):

*4.6.3. Company Overview*

- Name: BuildSmart Infra Pvt Ltd
- Industry: Commercial Construction

- Project Type: Hospitals, IT parks, roads
- Headquarters: Delhi NCR
- Annual Projects: 40–60
- Goal: Align with Science-Based Targets Initiative (SBTi)

*4.6.4. Challenge*

Scope 3 made up **92% of emissions** due to:

- Cement and steel production
- Equipment rental and transport
- Employee travel to construction sites
- Construction waste

**Table 6: Scope 3 Reduction in Infrastructure & Construction**

| Category | Activity | Emissions (kg CO2e) |
|---|---|---|
| Cement (5,000 tons) | High-emission material | 4,250,000 |
| Structural Steel (1,200 tons) | Fabricated offsite | 1,680,000 |
| Equipment Transport (diesel) | 200,000 km | 500,000 |
| Construction Waste | 1,000 tons | 200,000 |
| Employee Site Travel | 100 workers, 6 months | 150,000 |
| **Total Scope 3 (1 project)** | | **6,780,000** |

*4.6.5. Sustainability Measures*

- Low-Carbon Cement Alternatives: Switched to PPC (blended cement), which reduced emissions by 30%.[39].
- Green Procurement: partnered with steel suppliers to use solar-powered electric arc furnaces.
- Telematics for Fleet Optimization: reduce the number of unnecessary equipment transport trips by 35%.
- Waste Reuse: implemented recycling and garbage sorting on-site.

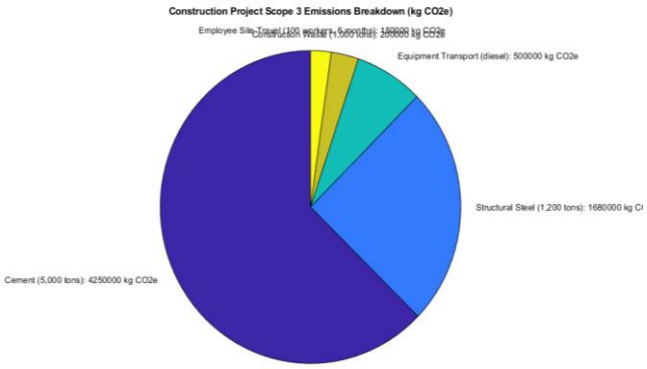


**Fig 8: Scope 3 Reduction in Infrastructure & Construction**

## 5. Conclusion

The multinational company Unilever makes a lot of consumer goods around the world. It's a good example of how sustainable supply chain methods can be used to cut down on Scope 3 emissions. Unilever has developed a multi-pronged strategy to combat the indirect causes of greenhouse gas (GHG) emissions, citing Scope 3 sources (raw material sourcing, product use, distribution, and end-of-life disposal) as the culprits responsible for over 90% of annual GHG emissions. To involve thousands of suppliers in the process of setting targets that are based on science and disclosing data on emissions, the company launched its Climate Program that enables concentrating on a collaborative strategy toward decarbonization at various levels of the supply chain. Besides that, Unilever has focused on sustainable sourcing of its main commodities like palm oil, soy, and paper, which is usually certified by third-party schemes and assisted by blockchain to track the supply chain. Overall, product redesign and reformulated products have helped lower emissions in the consumer use phase. This is because this part of its Scope 3 impact used to make up a big chunk of it, especially in areas like personal care and home use. Unilever is able to monitor events in real time, pinpoint problem areas, and forecast potential outcomes thanks to digital technology like AI and advanced analytics. This has greatly improved the company's ability to make decisions. The combination of these initiatives with its overall sustainability policy and science-based targets in accordance with the Paris Agreement has resulted in quantifiable improvements in its emission reduction coupled with operational resilience, brand equity and regulatory compliance. The case of Unilever is a vivid example of the potential to integrate modeling, supplier partnership, technological breakthrough, and the principles of the circular economy to deliver Scope 3 emissions reduction on a large scale.

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